

**THE VARIABLE R HYDRÆ.**—Dr. Gould, at Cordoba, has given much attention to the changes in this variable star, respecting which Argelander remarked that so long as observations were confined to European latitudes little would probably be understood, and he has deduced a formula closely representing the observations, excepting one by Maraldi, about which there appears to be a large error. The earliest recorded observations of this celebrated variable Dr. Gould remarks were those of Hevelius in April, 1662, published in the scarce volume of the "*Machina Cœlestis*" in 1679. Montanari of Bologna comparing Bayer's Uranometry with the sky on April 15, 1670, remarked it as a star of the fourth magnitude, not entered upon the map, and notified it as a new object. Its variability was recognised by Maraldi at Paris in 1704, who watched it at intervals till 1712. There then appears to be a gap in the observations until we come to those of Pigott in 1784 and 1785. Argelander collected and discussed all the observations to the beginning of 1863, and deduced a formula which fairly represented the data since 1784. The length of the period is decreasing rapidly, amounting, as Dr. Gould says, to more than nine hours at each successive recurrence—a circumstance which impeded the determination of the number of periods elapsed between Montanari's observation in 1670 and the first maximum noted by Pigott. Twelve periods having elapsed since the latest maximum included in Argelander's investigation, present data allow of clearing up several doubtful points.

Dr. Gould finds that the number of periods between the maxima of 1670 and 1784 must have been eighty instead of eighty-four, as assumed by Argelander, and the number between the maxima of 1670 and 1704 must have been twenty-three instead of twenty-five. Assuming that Maraldi's second maximum is erroneously dated in 1708, instead of 1707, he finds that all existing observations except Maraldi's first, may be represented within quite tolerable limits, "by supposing a uniform diminution in the period, upon which are superposed variable terms, according to which a symmetric perturbation completes its cycle in seventy-two years," and the following formula is finally inferred. The days are counted from the beginning of the year 1875:—

$$T = 35^{\circ}6'd. + 434^{\circ}44's. n - 0^{\circ}37974d. n^2 + 32^{\circ}0'd. \sin(5^{\circ}n + 10^{\circ}) + 2^{\circ}6'd. \sin(10^{\circ}n + 324^{\circ}) + 6^{\circ}8'd. \sin(15^{\circ}n + 205^{\circ})$$

It will be found that the formula fixes the next maximum to January 18, 1881; Schmidt alone has observed the minima, which occur on the average at about 9.16ths of the interval between the maxima.

**A NEW COMET.**—On the evening of September 29 Dr. Ernst Hartwig of the Imperial Observatory, Strassburg, discovered a bright comet about  $10^{\circ}$  north of Arcturus, and having obtained observations on three consecutive nights, has calculated the following elements:—

Perihelion passage, September 6.9528 M.T. at Berlin.

Longitude of perihelion ... ..	80 0'6"
ascending node ... ..	43 32'3"
Inclination of orbit ... ..	38 48'3"
Logarithm of perihelion distance ... ..	9.56450
Motion—retrograde.	

Hence he finds, for Berlin midnight:—

	R.A.			Decl.	Log. distance from Earth.			Sun.
	h.	m.	s.					
Oct. 6 ...	16	7	40	+24 35'5"	9.8147	...	9.9231	
8 ...	16	29	22	22 46'2"	9.8488	...	9.9432	
10 ...	16	47	18	21 3'5"	9.8827	...	9.9623	
12 ...	17	2	15	19 29'6"	9.9158	...	9.9805	
14 ...	17	14	51	+18 5'0"	9.9476	...	9.9978	

The intensity of light is rapidly diminishing, being on October 14 only one-sixth of that at the time of discovery.

The above orbit places the comet at 6 a.m. G.M.T. on September 12 near to Regulus, so that it is distinct from the object notified by Mr. Lewis Swift of Rochester, N.Y.

The comet was seen for a few seconds between clouds at the Royal Observatory, Greenwich, and at Mr. Barclay's observatory, Leyton, on the 5th, and is described by Mr. Talmage as "very bright," with a long tail."

### CHEMICAL NOTES

IN connection with the subject of water of hydration the results of Van Bemmelen, described in the *Berliner Berichte*, are of interest. He has determined the quantities of water

parted with, and also taken up by various hydrated oxides under different conditions of temperature and humidity of surrounding atmosphere. The results afford another instance of the graduation of chemical into physical actions. The amount of water taken up varies but little, but the strength of the combination varies much. The formation of hydrates appears to be a function of molecular weight of the oxide and of the temperature.

Two papers of great importance by Thomsen have just appeared in the *Berliner Berichte*. Thomsen attempts to base a general theory of the structure of carbon compounds on thermal determinations. He does this by measuring (indirectly, of course) the heat of dissociation of the carbon molecule, and from this and other data, finding a thermal value for the combination of two carbon atoms, to form a gaseous compound, by four, three, two, or one "link." Hence he deduces a thermal value for each "link." General equations are given for calculating the heats of formation of various isomers, assuming a certain "linking" of the atoms for each. In cases where various "linkings" may be assumed, a determination of the heat of formation may determine which "linking," and therefore which structural formula, is the more probable.

In a paper read before the Owens College Chemical Society Messrs. Bevan and Cross detail experiments on jute fibre, which lead them to regard the intercellular portion of this fibre as probably consisting of an aromatic compound of the quinone class, together with a substance allied to the carbohydrates, and somewhat of the nature of cellulose. The presence of this intercellular substance confers on jute the power of retaining various dye-stuffs. The authors also describe a method of separating cellulose from jute fibre, based on the action of chlorine or bromine, subsequent boiling with dilute caustic lye, and washing in acid. Jute fibre which has been acted on by chlorine is coloured deep magenta by immersion in a solution of sodium sulphite. The work of Messrs. Bevan and Cross promises results of considerable importance.

MR. O. HEHNER publishes in the *Antylst* the results of his determinations of phosphoric acid in potable waters. He concludes that the presence of more than 0.5 parts per million of  $P_2O_5$  should be regarded with suspicion; also that absence of phosphates affords no positive proof of freedom from pollution.

It is stated in the *Chemiker Zeitung* that if a solution of two parts of citric and one of molybdic acids be evaporated to dryness, heated to incipient fusion, and dissolved in 30 to 40 parts of water, a solution is obtained which imparts a blue colour to paper immersed in it, and dried at  $100^{\circ}$ . This paper is bleached by water, and may be used as a test for the presence of water in alcohol, ether, &c.

M. DE SCHULTER states in *Comptes rend.* that he has succeeded in preparing pellucid crystals of analcite by heating a solution of sodium silicate or caustic soda along with aluminous glass in sealed tubes to about  $190^{\circ}$ .

FROM analyses and determinations of specific heat of cerium tungstate, Cossa and Zecchini (*Gazzetta chim. Italiana* for July) think that the atomic weight of cerium is better represented by 92, the number formerly adopted, than by 138, which—or more probably 141—is generally regarded as correct. The data of the Italian observers are as follows:— $Ce_2(WO_4)_3$  ( $Ce = 141$ ) = 1026,  $\times 0.0821$  (sp. heat found) = 84.2, atomic heat of  $W = 6.4$ , of  $O = 4$ ; hence molecular heat of  $(WO_4)_3 = 67.2$ , but  $84.2 - 67.2 = 17$ , which  $\div 2$  gives 8.5 as the atomic heat of cerium.  $CeWO_4$  ( $Ce = 92$ ) = 340,  $\times 0.0821 = 27.9$ ; but  $27.9 - 22.4$  (that is, molecular heat of  $WO_4$ ) gives 5.5 as the atomic heat of cerium. The careful determinations of the specific heat of metallic cerium made by Hillebrand, and the general analogies of the cerium salts, must however be regarded as of more value in determining the atomic weight of this metal than a series of estimations of the specific heat of a compound containing oxygen, concerning the influence of which element on the specific heat of compounds thereof we have so little exact knowledge.

THERE has of late been a considerable amount of discussion as to the existence of pentathionic acid,  $H_2S_5O_6$ . In a recent paper in the *Journal of the Chemical Society*, Messrs. Takamatsu and Smith bring forward evidence which appears conclusively to prove that this acid does exist.

HELL has studied the action of bromine on acids of the acetic series, and in a paper in the *Berichte* he shows that the substitution of bromine for hydrogen proceeds slowly, until from

10 to 20 per cent. of the change is completed, then more rapidly until about 60 per cent. is reached, and then again slowly. He also shows that the greater the molecular weight of the acid the more rapidly is the period of maximum action reached. In these phenomena we have fresh examples of the so-called "Chemical Induction" of Bunsen and Roscoe. This supposed special phase of chemical change would indeed appear to be of very frequent occurrence, being only absent in those changes—if such exist—which consist of a single part, the direct change only.

BERTHELOT, in the *Comptes rendus* of the Paris Academy, describes experiments which lead him to believe that by the electrolysis of dilute sulphuric acid a new oxide of sulphur— $S_2O_7$ —is produced. This substance belongs to the class of peroxides, and is analogous with ozone and hydrogen peroxide; the formation of each of these substances is attended with absorption of heat. From the study of the thermal changes accompanying the solution of chlorine in aqueous hydrochloric acid and in water, the same author thinks that a trichloride of hydrogen,  $HCl_3$ , probably exists.

BOUSSINGAULT, in *Annales Chim. Phys.*, has examined the action of heat on barium dioxide under diminished pressure, and has shown that in a vacuum this substance parts with oxygen at a low red heat, and that oxygen is readily absorbed from the atmosphere by the baryta thus produced at about the same temperature, under ordinary pressures. It seems therefore that baryta may be employed as a carrier of oxygen from the atmosphere; hitherto the high temperature required for the decomposition of barium dioxide has brought about some molecular change in the baryta produced, which has rendered it incapable of absorbing more than very small quantities of oxygen from the atmosphere.

In *Comptes rendus*, Hautefeuille states that he has obtained crystals of orthoclase and of quartz in the same tube by heating a mixture of acid potassium phosphate—previously fused with silica and alumina—with silica and a little potassium fluosilicate in a glass tube.

RADZISZEWSKI in Liebig's *Annalen* gives a careful study of the conditions under which various carbon compounds exhibit phosphorescence; he concludes that this phenomenon occurs with those compounds which combine, in presence of alkalis, with the active oxygen of ozone or other peroxide. Phosphorescence he regards as a special case of the phenomenon of combustion; during slow oxidation active oxygen is produced; hence it is in such processes of oxidation that phosphorescence is noticed. When oxidation is rapid much of the active modification of oxygen is produced, combination occurs rapidly between this and the oxidising substance, and we have the phenomenon of combustion. The phosphorescence of certain organised creatures is due, according to the author, to the slow oxidation, by the agency of active oxygen, of such compounds as lecithin, cholesterolin, spermacetti, myricylic alcohol, sugar, fats, or ethereal oils. He shows that these substances are decomposed by cholin and neurin, and generally by bases of the formula  $R_3N.OH$  (where R is a monovalent alcoholic radicle, e.g.,  $CH_3.C_6H_5$ , &c.), and that this decomposition is attended with phosphorescence.

A SMALL pamphlet, "Report on Two Kinds of Coal submitted by the Chesapeake and Ohio Railroad Coal Agency," published by the Bureau of Steam-Engineering of the U.S. Navy Department, contains a detailed account of the methods of determining on the large scale the relative ratios of steam coals, which must be of very considerable service to any who require to perform such determinations.

If aluminium hydrate, obtained by precipitating a solution of alum by ammonia, be allowed to remain in contact with water for three or four months, it undergoes, according to M. Tommasi (*Comptes rendus*), a molecular change whereby it is rendered very much less soluble in acids, and is no longer capable of forming a compound with aluminium chloride.

### PHYSICAL NOTES

THE conditions of geysers are investigated at length by Herr Otto Lang in a recent paper to the Göttingen Society of Sciences (*Nachr.*, No. 6). The theory of Bunsen he considers inadequate, and he proposes another, which has an interesting similarity to that of Mr. Mallet regarding the mechanism of the intermittent volcano at Stromboli.

OBSERVATIONS as to the changes of length of iron bars through magnetisation having been somewhat discordant, Prof. Righi has lately taken up the subject afresh (*Il Nuovo Cim.*, ser. 3, tom. vii.), and, to measure the displacements, he attached a fine steel spring, with mirror, to one end of the bar (which was magnetised by means of a spiral), the mirror being observed through a telescope. Changes in length were thus magnified 8,000 times. The results were as follows:—1. Magnetism produces in iron and steel an increase of dimension in direction of the magnetisation. 2. On cessation of the magnetising force a part of this increase remains, and more or less of it according to the coercive force. 3. The elongations are proportional to the square of the current's intensity when this is not very great. 4. When, after a strong current through the spiral, a weak current is sent in the opposite direction, it produces a shortening; but even when it is strong enough to demagnetise the bar, the latter retains a greater length than in the normal state. 5. During reversal of the polarity of a bar its length becomes momentarily less, and it oscillates in length. 6. A bar or wire of iron traversed by a current contracts at the moment of closing the circuit. 7. On opening the circuit it elongates, but this elongation is less than the initial contraction, indicating that transverse magnetism partly remains. 8. In reversal of the transverse polarity the bar elongates for a moment, and thus oscillates in length. 9. The contraction produced by the current is greater when the bar has before been longitudinally magnetised. 10. Some iron bars show a tendency to take spiral magnetisation, i.e. to rotate the magnetic axes of their molecules in the direction of the spiral. This is shown by the contractions caused by a current passing through the bars, which are different according to the direction of the current and that of the previous longitudinal magnetisation.

THE absorption of radiant heat in gases and vapours form the subject of a recent valuable paper to the Vienna Academy (July 1) by Messrs. Lecher and Pernter. They consider "vapor-hesion" to have been an important source of error in Tyndall's experiments. In their own method the thermopile and the heat-source were brought into the same vessel. Air-currents were avoided by causing the surface of radiation to be heated in each case suddenly from without, by means of a steam jet, to 100° C. Among other results the absorption of water-vapour is found, in opposition to Tyndall, immeasurably small. Violle found, on Mont Blanc, that a metre of the air absorbed only 0.007 per cent. of the whole radiation; according to this, a layer of 300 m. length would be necessary to produce, with water-vapour saturated at 12°, that absorption which Tyndall obtains in 1.22 m. This and the authors' own experimental results are considered to prove beyond dispute the very small absorption of aqueous vapour. The authors' results for gases agree pretty well with Tyndall's. No simple connection between absorption and pressure of the substance was discoverable. The absorption, even for radiation of a heat-source of 100° C., is selective. The authors found the absorption of certain substances of the fat series examined to increase rapidly with increasing proportion of carbon. It seems to be otherwise, however, with bodies from other groups; thus, e.g. benzol, notwithstanding its six C-atoms, has a fairly small absorptive power.

MESSRS. A. P. LAURIE and C. I. BRUTON of Edinburgh have devised a new electromotor engine, in which four electromagnets act successively upon an eccentric armature of soft iron rotating about a central shaft, thus avoiding the back pull of Froment's and other forms of electromotor. The gradual approach thereby secured between the armature and the active field-magnets is a feature common to this engine and to that of Mr. Wiesendanger. The principle has long been applied, though somewhat differently, in the little motors employed for whirling Geissler's tubes.

SIGNOR MACALUSO has recently described a new form of mercurial air-pump, on the Sprengel principle, sufficiently simple to be capable of construction from the materials at hand in any chemical laboratory, and requiring no india-rubber connections. An outline diagram of the pump is given in the August number of the *Beiblätter*.

HERR A. SCHERTEL has determined the fusing-points of a number of difficultly-fusible substances by comparing them with those alloys of gold and platinum in various proportions. He gives the fusion-point of basalt as 1,166° C.; that of adularia (from the St. Gotthardt) is stated as being between 1,400° and 1,420°; and nickel between 1,392° and 1,420°.